Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Period: \_\_\_\_\_\_\_

**DNA to RNA to protein – Mutations – Change in your DNA (not your pocket). ☺**

Part 1: Inquiry into Sentence “Mutations”

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  | Sentences | **How did the sentence change?** | **Substitution, Deletion, or Insertion?** |
| 1. | original | The fat cat ate the wee rat. | The “c” in “cat” was replaced with a “k.” | Substitution |
| “mutated” | The fat kat ate the wee rat. |
|  | | | | |
| 2. | original | The fat cat ate the wee rat. | The “e” in “the” was deleted. This shortened the sentence. The letters that followed the “e” shifted to the right making the rest of the sentence look like gibberish. | Deletion |
| “mutated” | The fat cat ate thw eer at. |
|  | | | | |
| 3. | original | The fat cat ate the wee rat. |  |  |
| “mutated” | The fat cat zat eth ewe era t. |
|  | | | | |
| 4. | original | The fat cat ate the wee rat. |  |  |
| “mutated” | The fat caa tet hew eer at. |
|  | | | | |
| 5. | original | The fat cat ate the wee rat. |  |  |
| “mutated” | The fat cat ate the wee hat. |
|  | | | | |
| 6. | original | The fat cat ate the wee rat. |  |  |
| “mutated” | The fat cat tat eth ewe era t. |

Part 3: Inquiry into Mutations

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | DNA sequences | **How did the sequence change?** | **Substitution, Deletion, or Insertion?** | **Frameshift? (Yes or No)** |
| 1. | original | CCA GGT ACA TAC |  |  |  |
| “mutated” (changed) | CCA GTG TAC ATA C |
|  | | | | | |
| 2. | original | TCG AGC TAA GTC |  |  |  |
| “mutated” (changed) | TCG AGC TAA GGC |
|  | | | | | |
| 3. | original | AGG ATA CAA CGT |  |  |  |
| “mutated” (changed) | AGA TAC AAC GT |

Part 4: How mutations can affect proteins

*Directions*: Transcribe and translate the mutated DNA sequence and answer the questions.

|  |  |  |  |
| --- | --- | --- | --- |
|  | DNA | mRNA | Amino acids (proteins) |
| Normal | TAC GGA CGA TCT | AUG CCU GCU AGA | Met Pro Ala Arg |
| Mutated | TAC GGA CAT CT |  |  |

1. Was the mutation caused by deletion, insertion or substitution? EXPLAIN HOW YOU KNOW!

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Did the mutation cause a frameshift? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. How was the amino acid sequence (protein) changed?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Period: \_\_\_\_\_\_\_

**DNA to RNA to protein – Mutations PRACTICE – Change in your DNA (not your pocket).**

*Directions:* Transcribe the original DNA sequence. Then translate it into amino acids. (Use pg. 292)

|  |
| --- |
| **Original DNA Sequence**: T A C A C C T T G G C G A C G A C T  **Original mRNA Sequence:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  **Original Amino Acid Sequence:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |

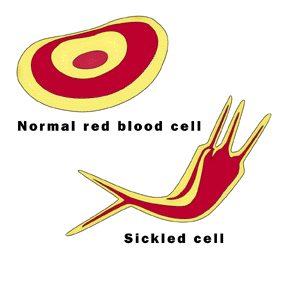
*Directions*: The original DNA has been mutated!

1. Circle the part of the DNA sequence that is different from the original DNA sequence.
2. Transcribe the DNA into mRNA
3. Translate the mRNA into an amino acid sequence Use pg. 292 in textbook to determine amino acids based on mRNA codons.
4. Determine if there will be effects or changes in the amino acid sequence (protein) made.
5. Identify the type of change (substitution, deletion, or insertion)

|  |
| --- |
| Mutated DNA Sequence #1*:* **T A C A T C T T G G C G A C G A C T**  *(Circle the change)*  What’s the mRNA sequence? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  What’s the amino acid sequence?  How does this aa sequence compare to the original?  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  What caused this mutation (substitution, insertion, or deletion)? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |

|  |
| --- |
| Mutated DNA Sequence #2*:* **T A C G A C C T T G G C G A C G A C T**  *(Circle the change)*  What’s the mRNA sequence? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  What’s the amino acid sequence?  How does this aa sequence compare to the original?  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  What caused this mutation (substitution, insertion, or deletion)? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| Mutated DNA Sequence #3*:* **T A C A C C T T A G C G A C G A C T**  *(Circle the change)*  What’s the mRNA sequence? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  What’s the amino acid sequence?  How does this aa sequence compare to the original?  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  What caused this mutation (substitution, insertion, or deletion)? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |

Case study: SICKLE CELL ANEMIA

*Background information*: A disorder called sickle-cell anemia results from a genetic change in the base sequence of DNA. Red blood cells in patients with sickle-cell anemia have molecules of hemoglobin that are misshapen. As a result of this change in the protein shape, sickled blood cells clog capillaries (small blood vessels) and prevent normal flow of blood to the body tissues, preventing proper oxygen delivery and causing severe pain.

The table below shows the sequence of bases in a short segment of DNA that codes for hemoglobin.

|  |  |  |  |
| --- | --- | --- | --- |
|  | DNA Sequence | mRNA sequence | amino acid sequence |
| Normal hemoglobin | GGG CTT CTT TTT |  |  |
| Sickled hemoglobin | GGG CAT CTT TTT |  |  |

1. a. Transcribe the DNA sequences into mRNA in the “mRNA sequence” column.

b. Translate the mRNA sequences into amino acid sequences in the “amino acid sequence” column.

1. Is sickled hemoglobin caused by a substitution, insertion or deletion? EXPLAIN YOUR ANSWER.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Compare the amino acid sequence of sickled hemoglobin to normal hemoglobin.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Why is the correct sequence of DNA bases important to the production of proteins?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_